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FUNCTIONAL ASYMMETRY OF POSTURE AND BODY SYSTEM REGULATION

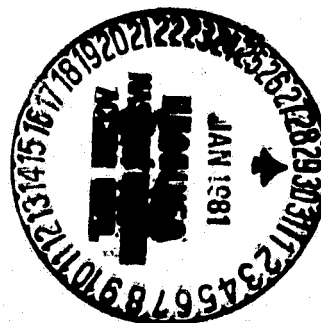
V. N. Boloban and A. P. Otsupok

(NASA-TM-76401) FUNCTIONAL ASYMMETRY OF  
POSTURE AND BODY SYSTEM REGULATION (National  
Aeronautics and Space Administration) 11 p  
HC A02/MF A01 CSCL 06P

N81-15687

G5/52 29685  
Unclass

Translation of "Funktsional'naya asimmetriya regul'yatsii pozy tela i  
sistemy tel," Teoriya i Praktika Fizicheskoy Kultury,  
No. 10, Oct. 1979, pp. 6-10.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546 SEPTEMBER 1980

1. Report No. NASA TM-76401	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle FUNCTIONAL ASYMMETRY OF POSTURE AND BODY SYSTEM REGULATION		5. Report Date September 1980	
		6. Performing Organization Code	
7. Author(s) V.N. Boloban, A.P. Otsupok Kiev State Institute of Physical Culture		8. Performing Organization Report No.	
		10. Work Unit No.	
9. Performing Organization Name and Address Leo Kanner Associates Redwood City, California 94063		11. Contract or Grant No. NASW-3199	
		13. Type of Report and Period Covered Translation	
12. Sponsoring Agency Name and Address National Aeronautics and Space Adminis- tration, Washington, D.C. 20546		14. Sponsoring Agency Code	
15. Supplementary Notes Translation of "Funktsional'naya asimmetriya regul'yatsii pozy tela i sistemy tel," Teoriya i Praktika Fizicheskoy Kul- tury, No. 10, Oct. 1979, pp. 6-10.			
16. Abstract The manifestation of functional asymmetry during the reg- ulation of an athlete's posture and a system of bodies and its effect on the execution of individual and group acrobatic ex- ercises were studied. Functional asymmetry of posture regula- tion was recorded in acrobats during the execution of individu- al and group exercises. It was shown that stability is main- tained at the expense of bending and twisting motions. It is important to consider whether the functional asymmetry of pos- ture regulation is left- or right-sided in making up pairs and groups of acrobats.			
17. Key Words (Selected by Author(s))		18. Distribution Statement This copyrighted Soviet work is reproduced and sold by NTIS under license from VAAP, the Soviet copyright ag- ency. No further copying is per- mitted without permission from VAAP.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 9	22.

# FUNCTIONAL ASYMMETRY OF POSTURE AND BODY SYSTEM REGULATION

V. N. Boloban and A. P. Otsupok

Kiev State Institute of Physical Culture

## Procedure

The athlete's efficient organization and realization of the potentialities of the motor apparatus is closely connected to the manifestation of functional asymmetry, which allows the development of the tactics and strategy of motor actions necessary for the attainment of the end result [1, 6, 7, 9, 10 and others]. Knowledge of posture and its statodynamic stability makes it possible effectively to form a motor habit and to perfect the skill of the athlete. The literary data [1, 3, 4, 5, 11, 12, 13 and others] indicate that the regulation of vertical posture has an asymmetrical character. Despite the period of more than 50 years since the publication of the first works, it is true that many questions (as applied to sports practice) are still unclear.

The manifestation of functional asymmetry during the regulation of an athlete's posture and of a system of bodies and its effect on the execution of individual and group acrobatic exercises were studied.

The subjects were masters of sport of the USSR for athletic acrobatics: Slepokurov--upper, Makarov--second middle, Vil'danov--first middle, Zolotov--lower, and also the strongest teams of four in the country: Zagorodskiy--upper, Fedorenko--second middle, Novitskiy--first middle, Tret'yakov--lower; Malyutin--upper, Kashuba--second middle, Derepa--first middle, Artemchik--lower.

Manifestations of functional asymmetry were studied while the athletes performed the following exercises: standing with feet together, hands on waist; standing on toes with feet together, arms up, eyes closed

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\* Numbers in the margin indicate pagination in the foreign text.

(Fig. 1); exercises in pairs (the interaction of partners in the pairs is presented in Fig. 2); I, II, III--closest in the functional plan of the interaction of group acrobats during the execution of a "column" pyramid; IV, V, VI--interactions that indirectly relate to the structural-functional building of a "column" pyramid; and, finally, exercises in a group: execution of a "column" pyramid (Fig. 3).

The statodynamic stability was recorded by a four-channel stabilograph [2]. The stabilograms, which reflect the directions of oscillations of the body and system of bodies forward and backward (S--sagittal plane), left and right (F--frontal), forward and to the left, backward and to the right ( $P_1$ --first intermediate plane), forward and to the right, backward and to the left ( $P_2$ --second intermediate), as well as the amplitude, frequency and period of the oscillations were analyzed. It was assumed that a large amplitude of oscillations in any of the intermediate planes ( $P_1$  or  $P_2$ ) indicates left-sided or right-sided functional asymmetry of posture and body system regulation.

Twisting and bending oscillations of the acrobats, performed by them to maintain stability, were analyzed by photographic data. By using questionnaires, the comfortable [preferred] side for executing a rond de jambe, pirouette and pas de cheval, was discovered and the posture of the leg (standing legs apart to the left (right)) during the executing of paired and group stationary exercises and pyramids were also fixed. The measurements were made in 1974, 1975 and 1976 during the competition.

## Results

The stabilograms that record the execution of individual control exercises have an asymmetrical character in direction, range, frequency and period.

The results of the experimental investigations of one group (Zagorodskiy, Fedorenko, Novitskiy, Tret'yakov) are presented in the table and in the figures. Over the course of three years measurements were made five times in this group. 200 stabilograms of the execution of

individual and group control exercises were recorded. During the execution of standing with feet together, hands on waist (see table and Fig. 1, a) in the upper, first middle and lower a larger range of oscillations was recorded in the S and  $P_1$  planes (frequency--in the  $P_1$  plane). In this case bending oscillations of the body (although insignificant) predominate in the forward-backward direction, and twisting--to the left. We called this phenomenon left-sided functional asymmetry /2 of posture regulation. In the second middle a greater range of oscilla-

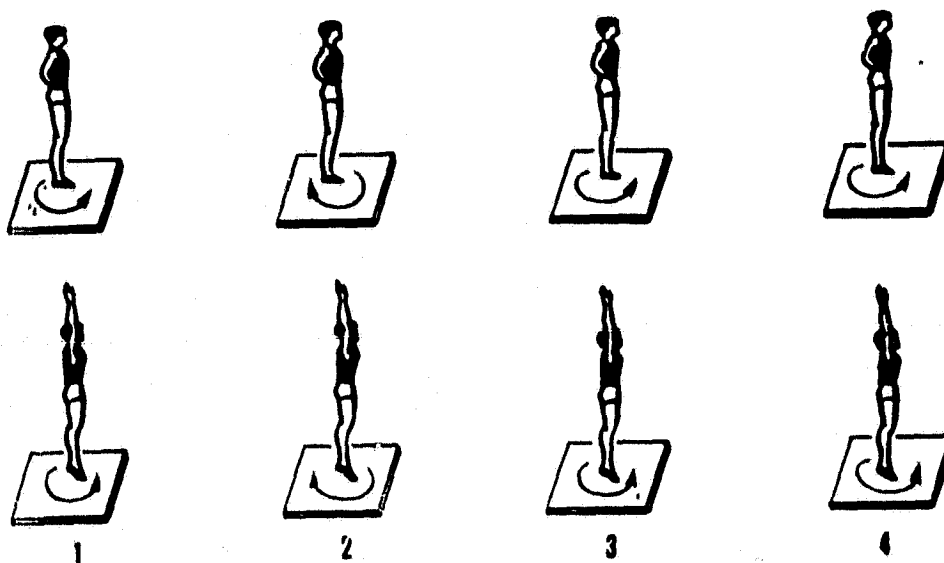


Fig. 1. Individual functional asymmetry of posture regulation of participants of group acrobatics during standing with feet together, hands on waist (a) and standing on toes with feet together, arms up, eyes closed. Key (for all the figures): 1) upper--Zagorodskiy, 2) second middle--Fedorenko, 3) first middle--Novitskiy, 4) lower--Tret'yakov.

tions was recorded in the S and  $P_2$  planes (frequency--in the  $P_2$  plane). Bending oscillations predominate in the forward-backward direction and twisting, to the right--the phenomenon of right-sided functional asymmetry of posture regulation. We shall note that Fedorenko carries out acrobatic elements with a turn to the right. The execution of the next, more complex, control exercise--standing on toes with feet together, arms up, eyes closed--confirms our preliminary conclusions. The decreased area of support when the body is raised on tiptoe and closing /2

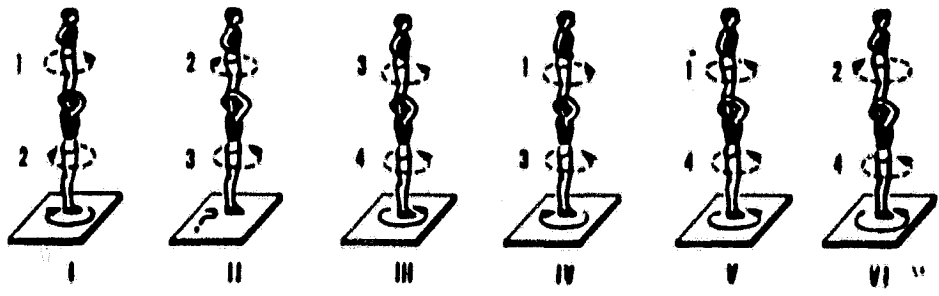


Fig. 2. Functional asymmetry of posture regulation of a pair of acrobats during standing on the shoulders of the partner. Six variants (I-VI) structurally and functionally stemming from the paired interaction. The individual data of posture regulation are shown by the dotted arrows, of body system regulation--by the solid arrows.

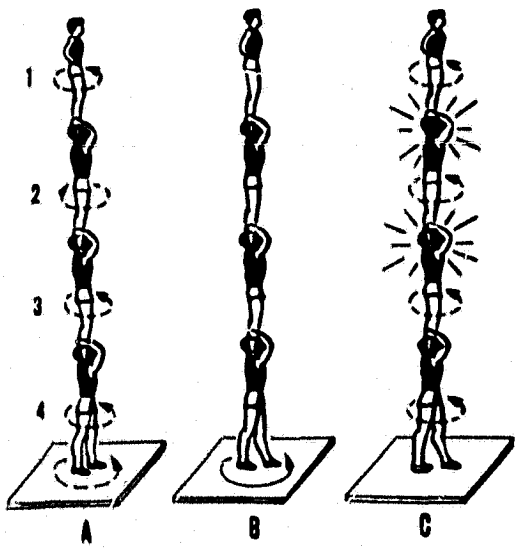


Fig. 3. Functional asymmetry of posture regulation of a group of acrobats (body system) during the execution of a "column" pyramid. A--probable model of functional asymmetry of posture regulation of the group of acrobats according to individual data. B--true functional asymmetry of posture regulation of the group of acrobats. C--probable model of functional asymmetry of posture regulation of the group of acrobats according to individual data with new second middle P. (the pyramid did not become stabilized).

the eyes led to significant increase of the range of oscillations and frequency of corrections, but did not change the kinematic and dynamic figures of posture regulation (see table and Fig. 1, b).

In the analysis of the stabilograms of standing on the shoulders of the partner we assumed that if the acrobats manifest functional asymmetry of posture regulation during fixation of individual postures they will also manifest them during interaction in pairs. Evidently, here there is an "adjustment" of the individual data of functional asymmetry to a total motor program of the body system. The results of

Stabilographic indices of posture and body system regulation during the execution of individual and group motor actions by athletes

Studied parameters	Amplitude A, mm					Frequency f, Hz					Period $m$ , sec				
	Direction of oscillations					Direction of oscillations					Direction of oscillations				
	S	T	P <sub>1</sub>	P <sub>2</sub>	X	S	F	P <sub>1</sub>	P <sub>2</sub>	X	S	F	P <sub>1</sub>	P <sub>2</sub>	X
Subjects															
Standing with feet together (individually)															
Zagorodskiy (upper)	3.4	3.0	3.2	2.9	3.12	2.0	1.7	2.3	1.9	1.97	0.5	0.59	0.43	0.52	0.51
Fedorenko (2nd middle)	3.1	2.7	2.8	3.2	2.95	1.9	1.6	1.3	2.0	1.7	0.52	0.62	0.77	0.5	0.6
Novitskiy (1st middle)	2.8	2.5	3.0	2.3	2.65	1.6	2.0	2.0	1.7	1.82	0.62	0.5	0.5	0.59	0.55
Tret'yakov (lower)	3.8	3.3	4.0	3.4	3.62	1.8	1.5	2.1	1.6	1.75	0.55	0.66	0.49	0.62	0.58
Standing on toes with feet together, arms up, eyes closed (individually)															
Zagorodskiy	16.1	16.7	21.0	17.2	18.0	6.8	5.3	4.8	4.2	5.275	0.147	0.19	0.29	0.238	0.188
Fedorenko	15.0	25.3	14.2	17.0	17.87	4.5	4.0	4.0	4.1	4.15	0.22	0.25	0.25	0.24	0.24
Novitskiy	46.8	28.0	42.0	21.0	34.45	5.0	5.5	5.2	4.8	5.125	0.20	0.18	0.192	0.208	0.195
Tret'yakov	31.4	20.4	27.0	19.6	21.6	3.1	1.6	5.0	3.5	4.125	0.29	0.21	0.20	0.28	0.21
Standing on the shoulders of a partner															
Zagorodskiy-Fedorenko	20.8	18.8	22.8	23.7	21.52	5.1	5.0	4.3	5.0	4.85	0.196	0.2	0.242	0.2	0.207
Fedorenko-Novitskiy	32.0	28.7	28.0	28.1	29.2	3.5	3.4	3.3	3.5	3.42	0.28	0.29	0.31	0.25	0.287
Novitskiy-Tret'yakov	39.3	27.7	34.5	26.0	31.87	3.2	3.0	3.8	3.4	3.35	0.31	0.33	0.26	0.29	0.297
Zagorodskiy-Novitskiy	48.3	26.6	28.8	29.8	33.37	3.2	3.7	3.2	3.7	3.45	0.21	0.27	0.31	0.27	0.299
Zagorodskiy-Tret'yakov	31.3	23.7	22.6	18.4	24.0	3.4	3.5	4.0	3.3	3.55	0.291	0.225	0.25	0.3	0.24
Fedorenko-Tret'yakov	30.0	22.6	18.4	17.5	22.0	3.5	3.3	3.6	3.5	3.475	0.288	0.30	0.277	0.28	0.28
Execution of "column" pyramid by four acrobats															
Zagorodskiy	}	52.3	30.1	40.5	36.8	39.92	3.3	3.7	3.6	3.2	3.45	0.3	0.27	0.28	0.31
Fedorenko															0.29
Novitskiy															
Tret'yakov															

Note: commas in tabulated material are equivalent to decimal points.



the investigations are presented in the table and in Fig. 2. When Zagorodskiy stood on Fedorenko's shoulders there was right-sided functional asymmetry of the body system posture regulation (dotted arrows on Fig. 2, 1). We believe that the second middle is a stronger balancer. He could thrust his tactics of motor interaction on the partner. Fedorenko contrasted the twisting oscillations to the right with twisting oscillations of the upper to the left against a background of bending oscillations. A high frequency of corrections as compared to the other pairs was recorded. We shall call the actions to maintain balance of the body system the tactic of synchronous and asynchronous antiphase interaction--it is as if the acrobats shut off the oscillations of the body system in the vertical by means of twisting oscillations in the opposing direction.

Other results of the execution of the control exercise in pairs are given in the table and in Fig. 2. Thus, left-sided functional asymmetry of body system posture regulation was obtained when Novitskiy stood on Tret'yakov's shoulders (III), Zagorodskiy on Tret'yakov's shoulders (V) and Fedorenko on Tret'yakov's shoulders (VI). The interaction of the second middle (2) and the lower (4) were especially indicative. The two most active balancers in the group, in whom there was a different manifestation of the phenomenon of functional asymmetry, were put together. The best sign of stability of the body system with left-sided functional asymmetry was obtained. Actually, Tret'yakov thrust his tactics of balancing on Fedorenko. We shall note that the lower executes all the acrobatic exercises with a turn to the left. During the holding of the "column" pyramid the lower takes a stance with legs apart, left ahead, and during the execution of all the paired exercises always interacts with the support. In the 1st and 3rd numbers individual left-sided functional asymmetry was obtained, but in the pair right-sided functional asymmetry of body system posture regulation was recorded. Evidently, for the maintenance of stability in the system the acrobats jointly develop by conditioned reflexes a new tactic of balancing which differs from the individual one. In a pair the 2nd and 3rd expressed functional asymmetry of posture regulation was not detected.

Before analyzing the acrobats' execution of the "column" pyramid, on the basis of the results of the stabilographic investigations of the execution of the individual and paired control exercises we constructed a probable model of the acrobats' interaction in the group during the execution of the column. The probable model is presented graphically in Fig. 3, A. According to our data, the upper, first middle and lower in the column implement primary twisting oscillations to the left, and the second middle--to the right. Creating antiphase rigid-resilient interactions in this way, the acrobats control stability. We also proposed that the body system posture regulation would have a left-sided functional character. The actual stabilogram on the whole confirmed the results of the probable model (see Fig. 3, B). The detected functional asymmetry has a left-sided character in most cases. For an explanation of the cited data, attention should be directed to the well-known work of B. V. Ognev [8] in which it is shown that, despite the more developed right half of the body (or possibly, precisely because of this), left-sided functional asymmetry predominates in the actions of humans.

Due to a number of reasons Fedorenko was replaced by master of sport P. in the team of four acrobats. Stabilograms of his stability showed that this acrobat also has a left-sided functional asymmetry of posture regulation. The manifestation of left-sided asymmetry in all four acrobats negatively affected the stability of the athletes during stabilization of the pyramids. Apparently this was the cause of their weak performance at routine competitions (Fig. 3, C). The acrobats resumed successful performances only with Fedorenko's return to the group.

### Conclusions

1. Functional asymmetry of posture regulation of the body and of a body system was recorded in acrobats during the execution of individual and group exercises. Stability is maintained at the expense of bending and twisting oscillations of the body.

2. Left-sided functional asymmetry of posture regulation is noted

in upper Zogorodskiy, first middle Novitskiy and lower Tret'yakov; right-sided, in second middle Fedorenko. This varied directionality of the twisting oscillations, which appears during the execution of the "column" pyramid, makes it possible to control the stability of the body system.

3. It is important to consider the manifestation of the phenomenon of functional asymmetry of posture regulation in making up pairs and groups of acrobats, and also in the selection of athletes.

4. Knowledge of the characteristics of the manifestation of functional asymmetry of posture regulation makes it possible to perfect the **instructional** and training procedure in athletic acrobatics.

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